

6. EDUCATION AND OUTREACH

6.1 Introduction

NASA's founding legislation directs the Agency to expand human knowledge of Earth and space phenomena and to preserve the role of the United States as a leader in aeronautics, space science, and technology. However, in recent years, undergraduate and graduate enrollment and the number of doctorates awarded in science and engineering have been declining. This trend, along with an aging workforce, places an increasing burden on NASA to maintain its level of achievement in science and technology.

The Laboratory's parent organization, the Earth Sciences Division (Code 610), has established a Committee for Education and Public Outreach, which is charged with coordinating these activities across the Division. Several Laboratory members are also on the ESD committee. Scott Braun, Goran Halusa, Paul Newman, and Lorraine Remer, are all working with David Herring, Program Manager for Education and Outreach, to achieve the Committee's objectives. More information may be found at <http://esdepo.gsfc.nasa.gov/index.php>.

6.2 Education

6.2.1 PUMAS—Practical Uses of Math And Science



Pumas is an online journal, a Web-based collection of brief examples aimed at giving K-12 teachers insights into how the math and science they teach are actually used in everyday life. This site was founded and is edited by **Ralph Kahn** (613.2), who joined the Laboratory in September 2007, coming from JPL. The examples are written primarily by scientists and engineers, and are available to teachers, students, and other interested parties via the PUMAS Web site (<http://pumas.nasa.gov/>). Scientists contribute their expertise by writing the examples, which may be activities, anecdotes, descriptions of “neat ideas,” formal exercises, puzzles, or demonstrations. These examples are widely used by pre-college teachers around the world to enrich their presentation of topics in math and science. PUMAS offers researchers a way to make a substantial contribution to precollege education with a relatively small investment of time and effort, and at the same time, to get a peer-reviewed science education journal article published on the Web. For further information contact Ralph Kahn (Ralph.Kahn@nasa.gov).

6.2.2 Interaction with Howard University and Other Historically Black Colleges and Universities (HBCUs)

Partnerships with Howard University:

A part of NASA's mission has been to initiate broad-based aerospace research capability by establishing research centers at the Nation's HBCUs. The Center for the Study of Terrestrial and Extraterrestrial Atmospheres (CSTEA) was established in 1992 at Howard University (HU) in Washington, D.C., as part of this initiative. It has been a goal of the Laboratory and the Earth Sciences Division to partner with CSTEA to establish at Howard University a self-supporting facility for the study of terrestrial and extraterrestrial atmospheres, with special emphasis on recruiting and training underrepresented minorities for careers in Earth and space science.

The Laboratory works closely with HU faculty in support of the Howard University Program in Atmospheric Sciences (HUPAS). HUPAS is the first M.S.- and Ph.D.-granting program in atmospheric sciences at an HBCU and the first interdisciplinary academic program at HU. Scientists from our Laboratory have contributed to the HUPAS program as lecturers, advisors to students, and adjunct professors who teach courses. A number of HU students have earned M.S. and Ph.D. degrees in atmospheric sciences.

Participation with Howard University on the Beltsville Campus Research Site:

Howard University has for several years been in the process of building a multi-agency, multi-university field observation research station at the Howard University Research site at Beltsville (HURB). This facility is part of the NOAA-Howard University Center for Atmospheric Science. David Whiteman (613.1), Belay Demoz (613.1, now at Howard University), and others from GSFC are assisting in mentoring students and advising with instrument acquisition for the site. One of the main instruments at the site is a world-class Raman lidar built with heavy involvement from Code 613.1.

During the summer of 2007, students from Howard University participated in the WAVES_2007 field campaign at the Beltsville site from July 14 to August 8. WAVES is a satellite validation, sonde, and other instrument inter-comparison field campaign centered on the Howard University Research site in Beltsville, Maryland. The main goal of this campaign was to acquire a statistically robust set of measurements of atmospheric water vapor, aerosols and trace gases useful for Aura/Aqua satellite retrieval studies as well as for performing instrument accuracy assessments, and for case studies of regional water vapor and aerosol variability. WAVES was the first major experiment held at HURB and as such required coordination within HU and with NASA GSFC, NOAA/Boulder, NWS/Sterling, and with many universities: UMCP; UMBC; Penn State; Bowie State; Trinity College in DC; Univ. of Virginia; Smith College, MA; Univ. of Wisconsin; and with universities from Brazil, Italy, and Bolivia.



Figure 6.1 A NASA civil servant and Everett Joseph of Howard University (second from left) training students from Howard University, Trinity College, Smith College, Univ. of Wisconsin, and UMCP on the details of multiple radio sounding launches on a single balloon.

Previous satellite validation activities have been hosted at sites such as the Department of Energy ARM sites that offer pristine measurement conditions not influenced by pollution sources and away from high population pressure, the Howard University Research site is in Beltsville, MD, a suburb of Washington, DC, and can be subject to periods of high pollution during the summertime. This fact, coupled with the heterogeneous terrain and the high population density makes satellite retrievals of such quantities as water vapor, ozone, and temperature more difficult. However, due to the large affected population and the proximity to the nation's capital, it is very important that satellite retrievals work well in such areas. The WAVES_2006 and WAVES_2007 field campaigns were held in July and August 2006 and 2007, to provide a high-quality set of ground-based and balloon-borne measurements to assess the quality of the retrievals from the Aura and Aqua sensors under the “difficult” retrieval conditions that exist in the mid-Atlantic region of the US during the summertime.

WAVES was funded by NASA SMD for two years. The core components of the WAVES funding include proposals awarded to HU, UMBC, and GSFC. For further information see the WAVES Web site, <http://ecotronics.com/lidar-misc/WAVES.htm>, or contact David Whiteman (David.N.Whiteman@nasa.gov).

6.3 Summer Programs

6.3.1 The Summer Institute in Atmospheric, Hydrospheric, and Terrestrial Sciences

The Summer Institute in Atmospheric, Hydrospheric, and Terrestrial Sciences was held from June 11 to August 17, 2007. The Institute is organized by Per Gloersen (Code 614.1) and is hosted by the Earth Sciences Division (Code 610). It is designed to introduce undergraduate students majoring in all areas of the physical sciences to research opportunities in these areas. After a one-week series of introductory lectures, the students select from a list of research topics and are mentored by a Goddard scientist for a period of nine weeks. At the conclusion of this period, the students give a presentation of their results. Laboratory scientists participating in the Institute, students, and research topics are shown in Table 6.1.

Table 6.1: Laboratory Scientists Mentoring Students in the 2007 Summer Institute

Mentor, Code	Student, University	Topic
Yang Hong, 613.1/GEST Bob Adler, 613	Stephanie Hill, Salisbury Univ.	A Study of Rainfall-Triggered Landslides on a Global Scale
Eric Wilcox, 613.2	Cody Fritz, Univ. of Missouri	The Effect of Aerosol on Stratocumulus Clouds in the Eastern-North Pacific
Rob Levy, 613.2/SSAI	Natalia Rodriguez, Universidad de Puerto Rico	Retrieval of Global Aerosol Properties: Validation and Climatology from MODIS
Menglin Jin, 613.2/UMCP Lorraine Remer, 613.2	Krista Romita, Vassar College	A Tale of Two Cities
Charles Ichoku, 613.2/UMCP	Shawn Gindhart, Millersville Univ	Compiling a Climatology of Smoke Plume Injection Heights from Measurements

Stephanie Hill compiled a database of 2007 landslides to compare with algorithm predicted landslides. Floods and associated landslides affect more people than any other type of natural disaster.

Cody Fritz used cloud radar data to investigate the possibility that structural differences between clouds in polluted and clean environments might mitigate the cooling effects of polluted clouds. For the region studied, it appears that liquid water path diminishes in polluted clouds (they're thinner), thus reducing the cooling effect.

Natalia Rodriguez participated in MODIS validation activities over the summer, comparing MODIS aerosol optical depth (AOD) and fine weighting (FW) with AERONET observations over five global regions. AOD correlates well, but FW is basically uncorrelated. These results are used to improve the MODIS retrieval algorithms.

In 'A Tale of Two Cities' (Beijing and New York in this case), Krista Romita presented a study of aerosol effects on radiative transfer and the consequent impact on urban climate systems. Data from AERONET sites in each city, MODIS observations, and radiative transfer models were used in the measurement of aerosol parameters (aerosol optical thickness, single scattering albedo, and asymmetry factor) and in the calculation of heating rates and radiative forcing. This study was aimed at obtaining a better understanding of urban microclimates and city-generated mesoscale circulations.

Shawn Gindhart used several NASA and other resources to locate fires and develop a climatology of smoke plume injection heights. Fire locations were obtained from MODIS, the Earth Observatory, and Google Earth. The heights were from two spaceborne lidars (GLAS and CALIPSO) and the MISR satellite. The resulting injection height climatology can provide estimates of pollutant lifetimes and consequently their range of environmental impacts, and can also be used for comparison with the results of plume rise models.

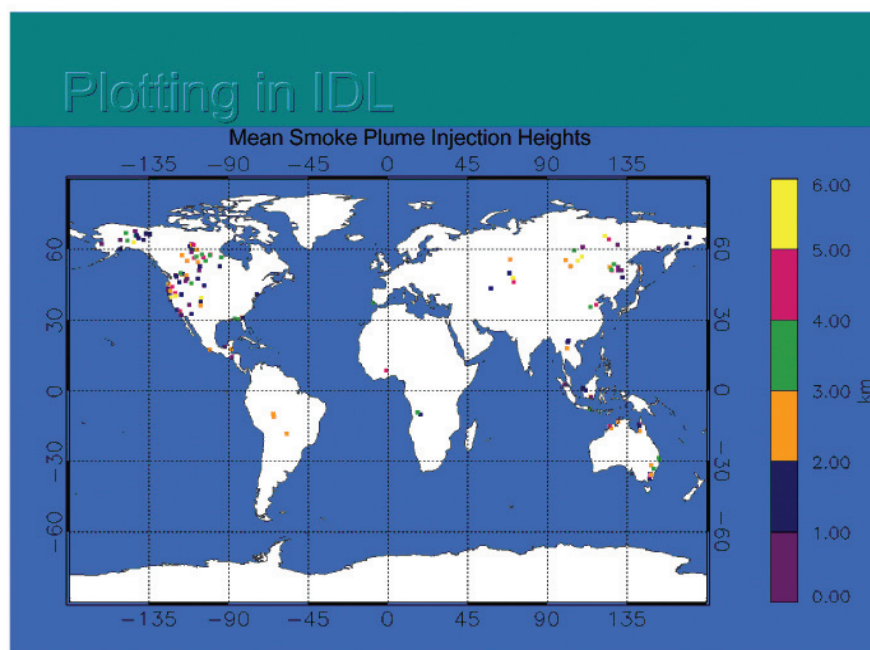


Figure 6.2 Plume injection height climatology (from the Summer Institute presentation of Shawn Gindhart).



Figure 6.3 Participants in the 2007 Summer Institute. Per Gloersen is at the left.

6.3.2 Research & Discover: Summer Internship Program in Earth Sciences

Research & Discover is a summer internship program jointly sponsored by the University of New Hampshire (UNH) and GSFC. It is available to students who have completed their junior year of college. Participants receive a stipend, as well as room and board. Following the first summer internship, participants are encouraged to apply for a second summer internship held at the NASA Goddard Space Flight Center. Following this internship, participants will be eligible to receive a two-year fellowship for graduate study at UNH. During summer 2007, Judd Welton of the Mesoscale Atmospheric Processes Branch, advised UNH student Virginia Sawyer on a project that utilized both MPLNET and CALIPSO backscatter lidar data to detect the planetary boundary layer. The results were given on August 9 in a presentation entitled “Automating Detection of the Planetary Boundary Layer in Aerosol Lidar Soundings.”

6.3.3 Goddard Earth Sciences and Technology (GEST) Center Graduate Student Summer Program: GEST-GSSP

NASA Goddard Space Flight Center's Earth Sciences Division, in collaboration with the Goddard Earth Sciences and Technology (GEST) Center of the University of Maryland, Baltimore County, offers a limited number of graduate student research opportunities through its Graduate Student Summer Program (GSSP). This prestigious program is in its eighth year and is designed to stimulate interest in interdisciplinary Earth sciences studies by enabling selected students to carry out an intensive research project at GSFC's Earth Sciences Division, which can be applied to the student's graduate thesis.

Positions are available to students interested in any Earth sciences field conducive to the research of NASA GSFC's Earth Sciences Division. Each student is teamed with a NASA Goddard scientist mentor with parallel scientific interests. NASA mentors can be drawn from any of the participating Earth Sciences Laboratories which include: the Laboratory for Atmospheres, the Hydrospheric and Biospheric Sciences Laboratory, the Global Modeling and Assimilation Office, the Global Change Data Center, and the Software Integration and Visualization Office. During the summer program, there is a lecture series aimed at current popular Earth sciences topics. At the conclusion of the program, students produce final oral and written reports on their summer research activities.

During the summer of 2007, Laboratory personnel acted as mentors for four GEST students. Mentors, students, and their research topics (if available) are given in Table 6.2.

Table 6.2: Laboratory Scientists Mentoring Students in the 2007 GEST-GSSP Program

Mentor, Code	Student, University	Report
William Lau, 613	Andrew Martin, Florida State University	
Wei-Kuo Tao, 613.1	Marcia DeLonge, Univ. of Virginia	Using Goddard Cumulus Ensemble model to investigate precipitation processes associated with African convective systems Using Goddard Cumulus Ensemble model to investigate precipitation processes associated with African convective systems
Bob Adler, 613 Yang Hong, 613.1/GEST	Dalia Bach, Columbia Univ.	
Ali Tokay, 613.1/JCET	Boone Larson	

6.3.4 GSFC High School Internship Program (HIP)

HIP is a research intensive program that allows interns to explore "real-time" applications of Science, Technology, Engineering, and Mathematics (STEM) disciplines. By the end of the summer, interns complete eight weeks of research on a project related to NASA's goals and deliver an oral technical presentation, sharing the results of their research with NASA management, scientists, and fellow interns.

Each HIP student is assigned a NASA scientist or engineer as a mentor and assists the mentor with his or her current project. The interns conduct research and use data for the projects, and the mentors guide the students and help them learn as much as possible from their experience at NASA Goddard.

This year's six-week program ran from June 25 to August 3. Anne Douglass of the Atmospheric Chemistry and Dynamics Branch advised student Xiaoxiao Lin on a study entitled "Comparing Ozone Simulated Data to MLS Aura Data—Finding Locations of Bias." The results were given at the NASA GSFC Summer 2007 Summer Internship Program Final Technical Presentations on August 1.

6.3.5 AMS Fellowship Winners' Visit

On June 5, 2007 the Earth Sciences Division hosted a visit to GSFC by a group of AMS Fellowship Winners. The visit was organized by the Laboratory for Atmospheres and consisted of a morning seminar and an afternoon tour of the clean room and other facilities in Building 29. The AMS Fellowship Program, established in 1991, has awarded over 200 fellowships to students entering their first year of graduate study in the atmospheric or related oceanic or hydrologic sciences, with the total dollars awarded reaching nearly \$3.5 million. The program is designed to attract promising young scientists to the AMS-related sciences and provide adequate funding for their first year, allowing the recipients to focus solely on their studies. The AMS is joined by industry leaders and Federal agencies in sponsoring the fellowships, which carry a \$22,000 stipend. The students, their areas of research interest, and universities are listed in Table 6.3.

Table 6.3: 2007 AMS Fellowship Winners Visiting GSFC

Student	University	Research Interest
Zachary Byco	Penn State University	Meteorology
Ariel Cohen	University of Oklahoma	Meteorology, Mesoscale Convective Systems
Gina Eosco	Cornell University	Communication Research
Jessica Fieux	Florida State University	Meteorology
Lauren Hand	University of Georgia	Concentration Factor Analysis to Relate Meteorological Parameters
Kimberly Klockow	University of Oklahoma	Meteorology
David Knight	University of Virginia	Environmental Sciences
Rebekah LaBar	University of Oklahoma	Meteorology, Mesoscale Convective Systems
Christopher McKinney	Texas A&M University	Atmospheric Sciences
Stephen Munchak	Colorado State University	Remote Sensing of Precipitation
Maryann Racine	Harvard University	Atmospheric Chemistry
Carlos Szembek	Yale University	Atmospheric, Ocean, and Climate Dynamics
John Williams	M.I.T.	Hurricane Research

During the morning seminar, presentations were given by scientists from the Laboratory for Atmospheres (Code 613), the Hydrospheric and Biospheric Sciences Laboratory (Code 614), and the Global Modeling and Assimilation Office (GMAO, Code 610.1). The agenda consisted of the following:

- 9:15–9:30: **William Lau**, Chief, Laboratory for Atmospheres (613)
Welcome and opening remarks.
- 9:30–10:00: **Ron Gelaro**, Global Modeling and Assimilation Office (610.1).
"Assessing the Impact of Observations on Numerical Weather Forecasts"

10:00–10:30: **Lorraine Remer**, Climate and Radiation Branch (613.2).
“Can Aerosols Save Us From Global Warming”

10:30–10:45: Break

10:45–11:15: **Lahouari Bounova**, Biospheric Sciences Branch (614.4).
“Combining Satellite Data and Models to Study Climate”



Figure 6.4 Lorraine Remer of the Climate and Radiation Branch (Code 613.2) addresses the AMS fellowship winners during their visit to GSFC.

During the afternoon, the AMS students toured facilities at Building 29, guided by Barbara Lambert, flight hardware photographer with SGT Corp.



Figure 6.5 Barbara Lambert, third from right in the black sweater, and AMS Fellowship Winners view the Hubble Space Telescope clean room in Building 29. A mockup of a shuttle control panel is at the left in this photo.

6.4 University Education

Laboratory members are active in supporting university education through teaching courses and advising graduate students. Table 6.4 lists instructors and courses taught.

Table 6.4: Courses Taught in 2007

University	Course	Instructor, Code
UMBC	PHYS 440/640, Computational Physics	David Lary, 613.3/UMBC
UMBC	Physics 602, Statistical Mechanics	Prasun Kundu, 613.2/JCET
Johns Hopkins Univ.	Physics 615.415.31, Statistical Mechanics and Thermodynamics	Prasun Kundu, 613.2/JCET

The following, Table 6.5, lists Laboratory members serving as graduate student advisors and/or on student Ph.D. committees. Committee members are indicated by an asterisk after the member's name and code. The actual or anticipated date of the student's dissertation defense, if available, is shown after the student name.

Table 6.5: Graduate Student Advising by Laboratory for Atmospheres Members

Member, Code	Student	Degree	Institution	Thesis Topic or Area
Oreste Reale, 613/ GEST	Marangelly Fuentes	Ph.D.	Howard University	Comparison of tropical cyclo- genetic processes in current global models
David Starr, 613.1	Tamara Singleton	Ph.D.	UMCP	Influence of Gravity Waves on Cirrus Clouds
Eyal Amitai, 613.1/ GMU	Xavier Lloret	Ph.D.	UPC, Barcelona, Spain	Radar Meteorology
Gerald Heymsfield, 613.1	Steven Guimond	Ph.D.	Florida State Uni- versity	Hurricane Hot Towers with Aircraft and Satellite Obser- vations
David Whiteman, 613.1	Rasheen Connell	Ph.D.	Howard University	A Numerical Model Charac- terizing the Performance of the Howard University Raman Lidar System
Wei-Kuo Tao, 613.1*	Jiwen Fan, August 2007	Ph.D.	Texas A&M Univ.	Cloud-Chemistry-Aerosol In- teractions
Wei-Kuo Tao, 613.1*	Thomas L. O'Halloran, Sum- mer 2007	Ph.D.	Univ. of Virginia	Cloud-Land-Vegetation Inter- actions
Steven Platnick, 613.2*	Joonsuk Lee, Spring 2007	Ph.D.	Texas A&M Univ.	Assessing Subvisual Cirrus with MODIS
Steven Platnick, 613.2	Brent Maddox	Ph.D.	Univ. of Wisconsin, Madison	Analysis of MODIS gridded cloud products
Charles Gatebe, 613.2	Juliao J. Cumbane	Ph.D.	Univ. of Johannes- burg, South Africa	Investigations of Clean Air Slots over Southern Africa from Multiangular Measure- ments
Tamas Varnai, 613.2/ UMBC	Philippe Chambon	Masters	Ecole Normale Su- périeure Lyon, Fr.	Influence of horizontal cloud variability on satellite retriev- als of cloud optical thickness
Kenneth Pickering, 613.3	Amanda Hansen	Ph.D.	Florida State Uni- versity	Development of a Lightning NO _x Parameterization for the WRF-Chem Model

Laboratory members participate with faculty at several joint centers identifying students whose research interests are shared by a faculty member and a Laboratory scientist. Students are encouraged to visit Goddard and it is anticipated that the Laboratory member will serve on the student's thesis committee. Table 6.6 lists students currently supported.

Table 6.6: Graduate Students Supported at the Joint Centers

Student	University	Topic	Advisor and/or Sponsor
Oleg Aulov	UMBC	Enabling Model Interactions in Sensor Webs	David Lary, 613.3/UMBC
Andrew Rickert	UMBC	Enabling Model Interactions in Sensor Webs	David Lary, 613.3/UMBC
Brittany McClure*	UMCP	OMI SO ₂ data validation with aircraft <i>in situ</i> data	Russell Dickerson, UMCP; Nickolay Krotkov, 613.3/GEST
Ravi Siddani**	UMBC	Space-time Statistics of Precipitation	Prasun Kundu, 613.2/JCET
Tabitha Huntemann	UMCP	Cloud-model Simulations of NO _x from Lightning	Kenneth Pickering 613.3

*Graduated in August 2007 from the Chemistry Department with a Masters degree.

** Received Ph.D. in December 2007.

6.5 Open Lecture Series

Distinguished Lecturer Seminar Series

One aspect of the Laboratory's public outreach is a Distinguished Lecturer Seminar Series, which is held each year and is announced to all our colleagues in the area. Most of the lecturers are from outside NASA and this series gives them a chance to visit with our scientists and discuss the latest ideas from experts. The following were the lectures presented in 2007.

January 25

Eric Smith, Mesoscale Atmospheric Processes Branch, NASA GSFC

"Advanced Technologies for Measurement of Precipitation from LEO and GEO Satellite Platforms"

February 15

Jose Rodriguez, Head, Atmospheric Chemistry and Dynamics Branch, NASA GSFC

"Understanding Processes and Uncertainties in Atmospheric Models: The Global Modeling Initiative"

March 16

Lorraine Remer, Climate and Radiation Branch, NASA GSFC

"Trends, Absorption, Aerosols and Clouds"

April 5

Robert Wilhelmson, National Center for Supercomputing Applications

"Storm Research and Education in the Context of Evolving Cyberinfrastructure and Petascale Computing"

April 19

Graeme Stephens, Colorado State University

"Early Science from CloudSat and the A-Train"

April 26

Robert Cahalan, Head of Climate and Radiation Branch, NASA GSFC

“The Sun, The Moon, and Central America”

May 17

Anthony Del Genio, NASA Goddard Institute for Space Studies

“Convective Cluster Lifecycles and Intensities”

June 12

Greg Holland, National Center for Atmospheric Research

“Anthropogenic Influences on Hurricanes in the North Atlantic”

August 15

Hui Su, Jet Propulsion Laboratory, California Institute of Technology

“Variation of Tropical Upper Tropospheric Clouds With Sea Surface Temperature and Associated Radiative Effects”

September 19, 2007

Stephen A. Klein, Lawrence Livermore National Laboratory

“What Does Weather-forecasting Offer Climate Models?”

6.6 Public Outreach

In addition to teaching and committee work, Laboratory members give seminars to university and other student groups and to public audiences.

January 9

Charles Jackman (613.3) presented a talk entitled “Has the Ozone Layer Changed?” to the Goddard Retirees and Alumni Association.

January 16

Andrew Negri (613.1/Emeritus) judged a science fair at Bladensburg Elementary.

February 20

Andrew Negri (613.1/Emeritus), judged a science fair at Eleanor Roosevelt HS.

March 23

As a committee member, **Ali Tokay** (613.1/JCET) attended the masters thesis defense of C. Malakpet of the University of Louisiana-Lafayette.

March 29

Ali Tokay (613.1/JCET) gave a seminar at the Interdisciplinary Remote Imaging and Sensing (IRIS) Research Center, Catholic University on March 29, 2007.

April 9

At the DoE/ARM Science Team Meeting, held March 26–30 in Monterey, CA, Felicity Russo, a Ph.D. graduate student at UMBC, presented a poster entitled “Measurements of Liquid Water Content with the ARM Raman Lidar at SGP.” Profile measurements of cloud liquid water content, cloud droplet radius, and cloud droplet number density based on new measurement capability installed in the ARM Raman lidar were presented. Retrievals of sub-cloud aerosol extinction from the same Raman lidar data have also been performed permitting the aerosol indirect effect parameter, IE as defined by Graham Feingold, to be evaluated. The results indicate that

changes in cloud droplet size are anti-correlated with changes in sub-cloud extinction for extinctions measured as much as 100 meters below the cloud but that the correlation decreases with increasing distance below the cloud. These measurements constitute what we believe to be the first remote sensing of the aerosol indirect effect using lidar. **David Whiteman** (613.1) is Ms. Russo's research advisor. **Belay Demoz** (613.1) is a member of her Ph.D. committee.

April 13

As a committee member, **Richard Stewart** (613) attended the Ph.D. thesis defense of Michelle Hawkins at Howard University. The thesis title was "Investigations of Ozone Concentrations in the Tropical Marine Boundary Layer during Saharan Dust and Biomass Burning Events." Ms. Hawkins passed the defense, subject to revisions in her thesis. She was the latest of a number of students awarded recent Ph.D.s in Atmospheric Sciences who started their graduate careers at Howard University in programs funded by NASA.

Eyal Amitai (613.1/GMU) gave an invited seminar on "Studying Rain Rate from Space, Ground and Underwater Observations: Present and Future" at the Italian National Research Council's Institute of Atmospheric Sciences and Climate (ISAC-CNR) in Bologna, Italy.

April 24

Paul A. Newman (613.3) gave a talk at the "Space and the Polar Regions" international seminar that was organized by the Embassy of France and George Mason University's Center for Aerospace Policy. Paul Newman's talk was "Polar ozone depletion: a satellite view." The meeting was held at George Mason University April 24-25.

May 2

David Whiteman and Belay Demoz (613.1) are members of the dissertation committee of Rasheen Connell, a graduate student in the Physics and Astronomy department of Howard University. Mr. Connell was admitted to Ph.D. candidacy by his committee after a successful presentation on May 2 of a research proposal entitled "A Numerical Model Characterizing the Performance of the Howard University Raman Lidar System."

May 9

Richard Stewart (613) served as a member of the GSFC High School Internship Program (HIP) selection committee. Of roughly 115 applicants 12 were selected for this program. HIP is a research-intensive, 8-week summer program that allows interns to explore applications of Science, Technology, Engineering, and Mathematics (STEM) disciplines to Goddard research.

Belay B. Demoz (613.1) attended the first meeting of the NASA Student Collaboration Program Definition Team. The 13-member SCPDT is charged to "develop a white paper capturing best practices in project-based learning exemplifying the nature of NASA's scientific exploration, explore additional learning opportunities of a similar character that is not part of a flight mission, and provide opportunities for community input, including conducting an open workshop." The SMD will publish the final report for wide distribution.

May 14

As a committee member, **Wei-Kuo Tao** (613.1) attended the Ph.D. thesis defense of Jiwen Fan at Texas A&M University. The thesis title was "Effects of Aerosols on Deep Convective Cumulus Clouds." Ms. Fan passed the defense. Jiwen Fan was a recipient of the NASA Earth Science Fellowship.

May 20

Khrystle C. Roberts from Trinidad and Tobago graduated from Trinity University in Washington, DC on May 20 with a double major in Chemistry and Environmental Science and as a recently elected member of Phi Beta Kappa. Her senior project was entitled "Comparing Chemical Reactions for Measuring Ground-level Ozone in the Atmosphere" and was derived from NASA-sponsored work that occurred during the WAVES_2006 field

campaign that was hosted at the Howard University research site in Beltsville, MD. **David Whiteman** and **Belay Demoz** (613.1) were the NASA leads of WAVES_2006.

June 6

Charles Jackman (613.3) gave a SESI talk titled “Has the Ozone Layer Changed?”

June 16

Scott Braun (613.1) participated in an “Ask An Expert” session at the Maryland Science Center in Baltimore, MD, on June 16. After the premiere of “Hurricane on the Bayou,” a new IMAX movie about Hurricane Katrina, Braun answered questions from movie viewers and other science center guests about hurricanes.

June 19

Charles Gatebe (613.2/GEST) gave a talk at the meeting of Oklahoma’s Ponca City Aviation Booster/Northern Oklahoma Flight Academy entitled “Understanding the Climate System through Observational data: CLASIC/CHAPS field experiment.”

June 26

Scott Braun (613.1) gave a talk on “NASA Hurricane Research” to middle school teachers involved in the NASA/Anne Arundel County Public Schools Summer Science Academy.

June 27

George Huffman (613.1/SSAI) and **David Bolvin** (613.1/SSAI) each hosted a teacher “job shadowing” as part of the Anne Arundel Public Schools summer teacher institute.

July 2

During June, **Bob Cahalan** (613.2) visited a rural primary school in El Silencio, Costa Rica that has participated in a pilot program of One Laptop Per Child. He discussed with them several programs that the children had developed to simulate space travel, and answered their questions about a variety of NASA activities. These included goals of the aircraft flights of several NASA aircraft over Costa Rica in July–August 2007, as part of the Tropical Composition, Cloud, and Climate Coupling (TC4) field deployment, in which scientists from Goddard will participate. The children asked him whether he planned to fly into space, and he answered that he and his science colleagues are now rather busy flying, and studying the many changes on Earth.

July 10

Public Lecture on Earth Science Research

Climate and Radiation Branch scientist, **Eric Wilcox** (613.2), gave a public lecture on Earth science research at NASA and the application of satellite technology to the study of Earth and the environment at the Squaw Valley resort near Lake Tahoe, California. This invited lecture was sponsored by the Squaw Valley Institute, a non-profit organization dedicated to hosting cultural events in the Squaw Valley, North Lake Tahoe community. Squaw Valley is a world-famous ski resort and site of the 1960 Winter Olympics.

July 31

Rich Stolarski (613.3) gave a talk entitled “Ozone—The Good: Stratosphere; The Bad: Troposphere” to a group of visitors from Howard University. The group consisted of Howard faculty, graduate students, and teachers from local schools. The interests of this group included chemistry, physics, biology, and genetics. The group was led by Greg Jenkins, Director of the Howard University Program in Atmospheric Sciences (HUPAS).

August 2

Scott Braun (613.1) and **Jeff Halverson** (613.1/UMBC) presented programmatic and research highlights related to hurricanes at the “About Goddard” event. Their presentations covered topics ranging from satellite applications to field experiments to numerical modeling and to new sensor development.

August 9

Charles Ichoku (613.2/UMCP) presented a public lecture entitled “How wildfires affect us all, far and near” to vacationers aboard a Royal Caribbean cruise ship, the Explorer of the Seas, while cruising the Caribbean and Bermuda.

September 16

On Sunday, September 16, 2007, **Richard Stolarski** (613.3) participated in panel discussions that were part of a science seminar held to celebrate the 20th Anniversary of the Montreal Protocol to limit ozone depleting substances in the atmosphere. The seminar was in Montreal, Canada as part of the 19th meeting of the parties. The parties consisted of delegations from the 191 countries that had signed the protocol, plus representatives from industry and non-government organizations. The meeting of the parties continued through the week of September 17–21. They are considering the possibility of expanding the protocol to include a faster phase-out of the HCFC compounds. The claim is that this would do more to mitigate global warming than the binding parts of the Kyoto Protocol.

September 18

Thomas Bell (613.2) gave an invited seminar at Texas A&M University titled, “The ‘Weekend Effect’ for Precipitation over Eastern U.S.: Evidence for Midweek Storm Intensification by Pollution” on September 18, 2007.

September 21

William Lau (613) was among five expert panelists who presented lectures at a public forum on “Hurricanes and Climate Change: What Have We Learned in the Past Two Years” at the Dirksen Senate Office Building, Capital Hill. The forum was hosted by the American Meteorological Society for the purpose of educating the public and Congress on important earth science issues affecting our society. Attendees include congressional staffers, representatives from Government agencies, journalists, science writers, and stake holders from industry. His lecture was entitled “Rainfall extremes, Saharan dust, tropical cyclones and climate change,” where he presented latest results from TRMM and MODIS, showing that tropical cyclones are increasingly feeding into extreme rainfall events, and that Saharan dust may be important in modulating hurricane statistics and seasonal hurricane predictions.

September 26

Scott Braun (613.1) participated in the Ph.D. thesis defense of Joseph Olson of State University of New York, Stony Brook University, on September 26, 2007. Olson’s thesis was “Structure and Dynamics of Barrier Jets along the Southeast Alaskan Coast.” Braun was invited to serve on Olson’s committee in 2004 because of his research, published in 1999, on idealized modeling of the effects of broad mountain barriers on upstream flow and on propagating cold fronts.

September 27

Kenneth Pickering (613.3) presented a lecture entitled, “Air Quality Science at NASA,” at the Goddard Visitor’s Center to a group of 11th grade students from Wakefield High School in Arlington, VA.

October 10

Charles Ichoku (613.2/UMCP) was an invited guest lecturer at a University of Maryland, College Park, undergraduate Honors Course (238-O) and delivered a lecture entitled, “The African Atmospheric Environment in the Age of Satellite Remote Sensing.”

October 18

Wei-Kuo Tao (613.1) presented an invited lecture on “Cloud-Resolving Models and their Applications on Precipitation Processes” to the graduate students of the Department of Meteorology at the University of Maryland.

October 30

Charles Ichoku (613.2/UMCP) was an invited guest lecturer at a University of Maryland, College Park graduate Honors Course on remote sensing, and delivered a lecture entitled, “Remote Sensing Provides the Ideal Tool for Measurement of Wildfires and Smoke Emissions.”

November 28

Scott Braun (613.1) presented an overview of NASA hurricane research to visitors from the Discovery Channel.

November 30

Scott Braun (613.1) was interviewed by John Hamilton of National Public Radio for a story on the 2007 hurricane season.

December 31

Eyal Amitai (613.1/GMU) gave an invited seminar at Tel Aviv University titled “Surface Rainfall Intensities from Satellite, Ground, and Underwater Observations.”

Undated

Chuck Cote (613/Retired) held discussions with Etienne Benson, a Ph.D. candidate from MIT, who is pursuing a degree in Wildlife/Biology and is doing research on the history of animal tracking. These discussions concerned a series of experiments with the Smithsonian Institution and the University of Wyoming that took place in the early 1970s using the Nimbus 3 and 4 IRLS (Interrogation, Location and Recording System) to track Elk in Wyoming and Montana. Etienne has completed a considerable amount of document research through the archives at the Smithsonian Institution on the subject but was missing some key facts and information. Cote was able to provide information, data, and photographs that Etienne needed to complete his dissertation in December. Cote agreed to be a reviewer of the draft dissertation.

6.7 Project Outreach

Funded projects in which Laboratory members participate contain elements of both education and public outreach that are described on the project Web sites. Some of these outreach efforts are summarized in the following sections.

TERRA

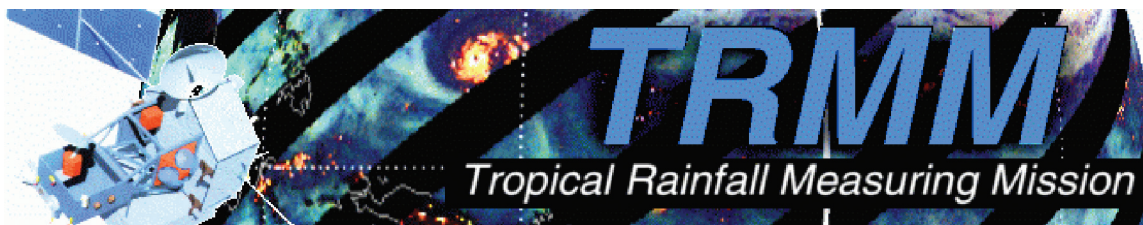


The EOS Terra outreach effort is a coordinated effort to foster greater cooperation and synergy among the various outreach groups within the EOS community. The Terra mission is designed to improve understanding of the movements of carbon and energy throughout Earth's climate system.

The “About Terra” link on the Terra home page (<http://terra.nasa.gov>) contains links to five tutorials designed to inform the public about the importance of the physical parameters observed by the instruments aboard the Terra spacecraft. These tutorials deal with the properties of aerosols, changes in cloud cover and land surface, the Earth's energy balance, and the role of the oceans in climate change. The home page also contains 14 direct

links to topics maintained by the Earth Observatory, an outreach site of the Committee for Education and Public Outreach. These links discuss a wide range of topics including Antarctica, flood plains, glaciers, air pollution, and volcanoes discussing each in the context of Terra observations and why such observations are important. The Terra Web site also contains a number of links under ‘Features’ to tutorials on topics of interest such as hurricanes and the cost of natural hazards. These tutorials are part of the NASA Earth Observatory Web site.

TRMM



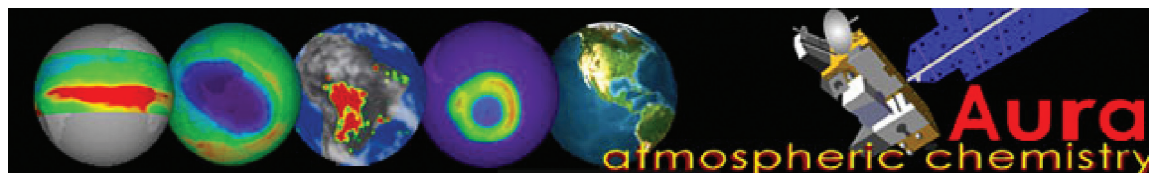
TRMM is a joint mission between NASA and the Japan Aerospace Exploration Agency (JAXA) designed to monitor and study tropical rainfall. TRMM continues its comprehensive Education/Outreach program, in which Laboratory personnel promote TRMM science and technology to the public under the leadership of TRMM Project Scientist Robert Adler (Code 613, Emeritus). TRMM has also included the development of broadcast visuals and educational curriculum in its outreach activities. The Educational Resources link on the TRMM home page leads to five problem-based classroom modules in PDF format. These manuals are titled “Investigating the Climate System” and consist of tutorials on clouds, winds, precipitation, weather, and energy. The first four are appropriate for students in grades 5–8, the last is directed at students in grades 9–12. These packages are available on the TRMM Web site (<http://trmm.gsfc.nasa.gov/>) and have been reviewed as a part of the Earth Science Enterprise (ESE) Education product review. There are also 11 educational videos that give brief tutorials on various aspects of the TRMM project and on the atmosphere’s water and energy cycles.

Global Precipitation Measurement (GPM)



The GPM is a follow-on, and expanded, mission of the current ongoing TRMM. GPM is one of the Earth Observing System programs, mainly initiated by JAXA, the National Institute of Information and Communications Technology (NICT), and NASA. Both the ‘Science’ and ‘Public Outreach’ links on the GPM Web site (<http://gpm.gsfc.nasa.gov/index.html>) contain a wealth of educational materials. The ‘Science features’ section on either page has links to numerous additional discussions of the satellite, its instruments, and what will be measured.

EOS Aura



The Aura satellite was launched from Vandenberg AFB on July 15, 2004. The Laboratory for Atmospheres has responsibility for conducting the Education and Public Outreach program for the EOS Aura mission. Aura's Education and Public Outreach program has four objectives:

- (1) Educate students about the role of atmospheric chemistry in geophysics and the biosphere;
- (2) Enlighten the public about atmospheric chemistry and its relevance to the environment and their lives;
- (3) Inform geophysics investigators of Aura science, and thus enable interdisciplinary research; and
- (4) Inform industry and environmental agencies of the ways Aura data will benefit the economy and contribute to answering critical policy questions regarding ozone depletion, climate change, and air quality.

To attain these objectives, the Aura project supports a strong educational and public outreach effort through formal and informal education partnerships with organizations that are leaders in science education and communication. Partners include the Smithsonian Institution's National Museum of Natural History (NMNH), the American Chemical Society (ACS), and the Global Learning and Observations to Benefit the Environment (GLOBE) Program. Our goals are to educate students and the public and inform industry and policy makers how Aura will lead to a better understanding of the global environment.

NMNH, working with Aura scientists, will design and create an interactive exhibit on atmospheric chemistry as part of its Forces of Change program. NMNH will convey the role that atmospheric chemistry plays in people's lives through the use of remote sensing visualizations and museum objects.

The ACS has produced special issues of the publication ChemMatters. These issues focus on the chemistry of the atmosphere and various aspects of the EOS Aura mission. The special editions of ChemMatters will reach approximately 30,000 U.S. high school chemistry teachers and their students.

The Globe Program is a worldwide network of students, teachers (10,000 schools in over 95 countries), and scientists working together to study and understand the global environment. Drexel University's (Philadelphia, PA) ground-based instruments will measure ultraviolet-A (UV-A) radiation and aerosols to support measurements taken from the Aura spacecraft. A tropospheric ozone measurement developed by Langley Research Center is also a GLOBE protocol.

Aura's Education and Project Outreach program will also be present at science and environmental fairs and science and technology conferences to demonstrate how Aura fits into NASA's program to study the Earth's environment. The Aura Web site is <http://aura.gsfc.nasa.gov/>.

TOMS



The Atmospheric Chemistry and Dynamics Branch is committed to quality scientific education for students of all ages and levels. The TOMS Web site contains resource materials for science educators at <http://toms.gsfc.nasa.gov/teacher/teacher.html>. Three lessons that make use of TOMS data and that study the uses of Earth-orbiting satellites are presented at this site. One of these is directed at students in grades 5–8, others are directed to those in grades 9–12. There is also a link to five projects for independent research, which allow advanced students to learn more about atmospheric chemistry and dynamics.

There is also an online textbook at http://www.ccpo.odu.edu/SEES/ozone/oz_class.htm written by Branch scientists. This textbook was designed as an educational resource for the general public, as well as for students and educators. It contains 12 chapters covering all aspects of the science of stratospheric ozone. Each chapter has numerous low- and high-resolution figures, and ends with a set of review questions.